

In The Claims

Claim 1 (currently amended): An ultraviolet (UV) curing A—method for enhancing the application of applying UV light to UV photo initiators in a UV curable items comprising products, articles, inks, coatings, adhesives, or other objects, comprising the steps of:

emitting visible light from a set of visible light-emitting diode (LED) assemblies secured to a panel;

emitting a first wavelength of UV light from a first array of UV LED assemblies secured to the panel;

emitting a second wavelength of UV light from a second array of UV LED assemblies secured to the panel, said second array of UV LED assemblies being different than said first array of UV LED assemblies, and said second wavelength of UV Light being different than said first wavelength of UV light;

moving the panel in proximity to or adjacent the UV curable items while emitting light from the LED assemblies;

uniformly and concurrently applying and distributing the first and second wavelengths of UV light on the UV curable items while emitting the visible light as the panel is being moved; and

uniformly curing the UV curable items.

~~positioning a plurality of UV LED assemblies that emit light at wavelengths between 180 and 420 nm in a row on a panel;~~

~~arranging the UV LED assemblies in the row so that adjacent UV LED assemblies emit UV light at different wavelengths; and,~~

~~moving the panel relative to a UV curable product to distribute the UV light at different wavelengths across the UV curable product.~~

Claim 2 (currently amended): The UV curing method of claim 1 wherein the first and second arrays of UV LED assemblies emit UV light at wavelengths between 315 and 400 nm.

Claim 3 (currently amended): The UV curing method of claim 1 wherein some of the first array of UV LED assemblies emit UV light at a peak wavelength of 365 nm and other of the second array of UV LED assemblies emit UV light at a peak wavelength of 385 nm.

Claim 4 (currently amended): The UV curing method of claim 1 including: the step of

injecting an inert gas in a space between the panel and the UV curable product items; and

protecting the LED assemblies from splatter

Claims 5-6 (canceled)

Claim 7 (currently amended): The UV curing method of claim 1 including the step of cooling the first and second arrays of UV LED assemblies to keep the temperature of the UV LED chips within a predetermined range with at least one heat sink, fin, or fan.

Claims 8-10 (canceled)

Claim 11 (currently amended): The UV curing method of claim 1 including the step of placing the first and second arrays of UV LED assemblies at a distance from the UV curable product items which will provide a substantially uniform pattern of UV light diverging from the first and second arrays of UV LED assemblies of at least 50% of the power output from the UV LED assemblies according to a viewing cone angle of 20°.

Claim 12 (canceled)

Claim 13 (currently amended): The UV curing method of claim 1 including varying the step of selecting UV LED chips for the UV LED assemblies wherein the current drawn by the UV LED chips of the first and second arrays of UV LED

~~assemblies only varies between about 5% and about 10%, thereby to minimize "current hogging" by the UV LED chips in the UV LED assemblies.~~

Claims 14-15 (canceled)

Claim 16 (currently amended): An ultraviolet (UV) apparatus for enhancing the application of applying UV light to UV photo initiators in a UV curable items comprising products, articles, inks, coatings, adhesives, or other objects, comprising: a panel;

a set of visible light-emitting diode (LED) assemblies secured to said panel for emitting visible light;

a first array of UV LED assemblies secured to said panel for emitting a first wavelength of UV light;

a second array of UV LED assemblies secured to said panel for emitting a second wavelength of UV light, said second array of UV LED assemblies being different than said first array of UV LED assemblies, said first wavelength of UV light being different than said second wavelength of UV light;

a panel-moving mechanism for moving said panel in proximity to or adjacent to the UV curable items while light is emitted from the LED assemblies; and

a controller operatively connected to the LED assemblies and the panel-moving mechanism for uniformly and concurrently applying and distributing the first and second wavelengths of UV light from the UV LED assemblies on the UV curable items while visible light is emitted from the visible LED assemblies as said panel is being moved to uniformly cure the UV curable items.

a plurality of UV LED assemblies that emit light at wavelengths between 180 nm and 420 nm arranged in a row on a panel;

the UV LED assemblies in the row being arranged so that adjacent UV LED assemblies emit UV light at different wavelengths; and,

a panel-moving device for moving the panel relative to a UV curable product to distribute the UV light at different wavelengths across the UV curable product.

Claim 17 (canceled)

Claim 18 (currently amended): The UV curing apparatus of claim 16 wherein some of the first array of UV LED assemblies emit UV light at a peak wavelength of 365 nm and other of the second array of UV LED assemblies emit UV light at a peak wavelength of 385 nm.

Claim 19 (currently amended): The UV curing apparatus of claim 16 including a gas injector for injecting wherein an inert gas is placed in a space between the panel and the UV curable items product.

Claim 20 (currently amended): The UV curing apparatus of claim 16 including a splatter resistant wherein a protective device comprising a plastic or glass sheet or plate is placed positioned between the UV LED assemblies and the UV curable products items for substantially preventing splatter from the UV curable items from contacting the UV LED assemblies.

Claim 21 (canceled)

Claim 22 (currently amended): The UV curing apparatus of claim 16 including cooling equipment means for cooling the UV LED assemblies to keep the temperature of the UV LED UV LED assemblies chips within a predetermined range, said cooling equipment comprising a cooling device selected from the group consisting of a heat sink, fin, and fan.

Claims 23-26 (canceled)

Claim 27 (currently amended): The UV curing apparatus of claim 16 wherein the UV LED chips in the UV LED assemblies are comprise large junction UV-LED chips (over 400 microns on a side) for emitting UV light at a higher light density.

Claim 28 (currently amended): The UV curing apparatus of claim 16 wherein the UV LED chips for the UV LED assemblies comprise UV LED chips with have a current

drain which only varies between 5% and 10%, thereby to minimize "current hogging" by the UV LED chips in the UV LED assemblies.

Claims 29-30 (canceled)

Claim 31 (currently amended): An ultraviolet (UV) curing method for enhancing the application of applying UV light to UV photo initiators in a UV curable items comprising products, articles, inks, coatings, adhesives, or other objects, comprising the steps of:

emitting UV light from positioning a plurality of UV LED chips on a substrate;
mounting a heat sink on the substrate;

cooling the UV LED chips with a positioning a variable speed fan and a adjacent the heat sink;

moving causing relative movement between the substrate and a UV curable product, article, ink, coating, adhesive or other object to illuminate the relative to the UV curable items product, article, ink, coating, adhesive or other object with UV light to cure the product, article, ink, coating, adhesive or other object;

sensing one of the light intensity of the UV light emitted from the UV-LED chips; or

sensing the temperature of the heat sink or UV LED chips; and,

controlling the temperature of the heat sink to control the light intensity from three UV LED chips by controlling the cooling air blown by the fan toward the heat sink by adjusting and controlling the speed of the variable speed fan in response to one of the light intensity sensed or the sensed temperature of the heat sink or UV LED chips; sensed, thereby to

maintaining the temperature of the UV LED the UV LED chips at a generally constant temperature; which results in

maintaining the light intensity of the UV light emitted on the UV curable items at a generally constant level; and light output from the UV LED chips.

uniformly curing the UV curable items.

Claim 32 (currently amended): An ultraviolet (UV) curing apparatus for enhancing the application of applying UV light to UV photo initiators in a UV curable items comprising products, articles, inks, coatings, adhesives, or other object, comprising:

a plurality set of UV LED chips mounted on a substrate for emitting UV light on the UV curable items;

a heat sink mounted on said substrate for dissipating heat from said UV LED chips;

a variable speed fan mounted adjacent said heat sink for blowing air on said heat sink or UV LED chips to cool said heat sink or UV LED chips;

a moving mechanism for causing relative movement between said substrate and the UV curable items product, article, ink, coating, adhesive or other object to illuminate the UV curable product, article, ink, coating, adhesive or other object with UV light to cure the UV curable product, article, ink, coating, adhesive or other object;

a light sensor for sensing the intensity of UV positioned to sense light emitted from said UV -LED chips; and,

a control circuit coupled to said light sensor and to said variable speed fan for controlling the temperature of said heat sink to control the light intensity of the UV light emitted from said UV -LED chips and the temperature of the UV LED chips by regulating the speed of the cooling air blown by said variable speed fan on toward said heat sink or UV LED chips and by varying or adjusting the speed of said variable speed fan in response to the light sensed intensity sensed of the UV light to uniformly cure the UV curable items.

Claim 33 (currently amended): An The UV curing apparatus for enhancing the application of UV light to UV photo initiators in a UV curable product, article, ink, coating, adhesive or other object, comprising of claim 32 including:

a plurality of UV LED chips mounted on a substrate;

a heat sink mounted on said substrate;

a variable speed fan mounted adjacent said heat sink;

a moving mechanism for causing relative movement between said substrate and the UV curable product, article, ink, coating, adhesive or other object to illuminate the

~~UV curable product, article, ink, coating, adhesive or other object with UV light to cure the UV curable product, article, ink, coating, adhesive or other object;~~

~~a temperature sensor mounted adjacent on said heat sink or UV LED chips and coupled to said; a control circuit coupled to said temperature sensor and to said fan for controlling the temperature of said heat sink to control the light intensity from said UV LED chips by regulating the cooling air blown by said fan toward said heat sink by varying or adjusting the speed of said fan in response to the temperature sensed for sensing the temperature of said heat sink or UV LED chips.~~

Claims 34-36 (canceled)

Claim 37 (currently amended): The UV curing apparatus of Claim 32 including: printing and curing station of claim 36 wherein:

a printer with a printing head for printing UV curable ink on the UV curable items;

said support is a turntable for carrying the printed UV curable items past the UV LED chips; and products beneath spaced apart printing heads and spaced apart UV LED assemblies; and,

said one moving a mechanism for rotating or indexing rotates or indexes said turntable carrying the printed UV curable items past the UV LED chips.

Claim 38 (currently amended): The printing and curing station UV curing apparatus of claim 3235 wherein:

said second moving mechanism iscomprises a conveyor which also defines said support and said conveyor is constructed and arranged to move products under said UV LED assembly for moving the UV curable items past the UV LED chips as UV light is emitted from the UV LED chips.

Claim 39 (currently amended): The UV curing apparatus printing and curing station of claim 3235 wherein said second moving mechanism is constructed and arranged to reciprocate said UV LED assembly over products on said support, which is stationarycomprises an oscillator for oscillating or reciprocating said substrate of UV

LED chips in proximity to or adjacent said UV curable items as UV light is emitted from said UV LED chips.